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Artigo Original

2 **TENDÊNCIAS DE COMPORTAMENTO SEDENTÁRIO ENTRE**

3 **ESTUDANTES DO SUL DO BRASIL**

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20 **Resumo**

21 **Introdução:** O comportamento sedentário tem sido motivo de preocupação para os
22 pesquisadores no mundo, especialmente no Brasil. **Objetivo:** Este estudo comparou
23 a atividade física moderada-vigorosa e o comportamento sedentário em dois anos
24 de dois levantamentos (2008 e 2017), relacionando esses comportamentos à
25 circunferência abdominal. **Métodos:** Estudo transversal, com 1.783 alunos, de
26 ambos os sexos, com idade entre 10 e 17 anos: 2008 (n = 977) e 2017 (n = 806). Os
27 estudos foram realizados em escolas públicas de um município do sul do Brasil. O
28 nível de atividade física foi avaliado por meio de um questionário de gasto
29 energético. A circunferência abdominal foi considerada alta $\geq 75^{\circ}$ percentil para
30 idade e sexo. Os estudantes foram agrupados de acordo com os níveis de atividade
31 física moderada-vigorosa. O tempo sentado foi considerado comportamento
32 sedentário. **Resultados:** A proporção de meninos ativos em 2008 (62,2%) foi maior

33 do que em 2017 (34,1%; $p < 0,001$), enquanto a frequência de obesidade abdominal
34 foi maior em 2017 (meninos 36,3%, meninas 25,5%) do que em 2008 (15,7% e
35 10,5%; $p < 0,001$, respectivamente). Em 2017, houve um aumento de 2,8 vezes no
36 risco de prevalência de circunferência abdominal aumentada em relação a 2008 (p
37 $< 0,001$), que foi diretamente relacionado ao aumento de 16,5 vezes no risco de
38 comportamento sedentário elevado ($p < 0,001$) e duas vezes de aumento em quem
39 pratica atividade física moderada-vigorosa < 60 min / dia ($p < 0,001$). **Conclusão:** O
40 risco de obesidade abdominal aumentou na última década em ambos os sexos, o
41 que parece ser principalmente devido ao comportamento sedentário, além do
42 menor nível de atividade física moderada-vigorosa em meninos.

43 **Palavras-chave:** Comportamento sedentário, Circunferência abdominal,
44 Antropometria, Adolescentes, Atividade física.

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Original Article

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TRENDS IN SEDENTARY BEHAVIOR AMONG THE SOUTH

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BRAZILIAN STUDENTS

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Abstract

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Introduction: Sedentary behavior has been a matter of concern for researchers around the world, especially in Brazil. **Objective:** This study compared the moderate–vigorous physical activity and sedentary behavior between the years of two surveys (2008 and 2017), relating these behaviors to waist circumference.

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Methods: Cross sectional study, included 1783 students, both sexes, aged 10 to 17 years were considered: 2008 (n = 977) and 2017 (n = 806). The studies were carried out in public schools in the municipality of southern Brazil. The level of physical activity was assessed through an energy expenditure questionnaire. The waist circumference was considered high ≥ 75 th percentile for age and sex. The students were grouped according to the levels of moderate–vigorous physical activity. Sitting time was used as a proxy of sedentary behavior. **Results:** The proportion of active boys in 2008 (62.2%) was higher than in 2017 (34.1%; $p < 0.001$) while the frequency of abdominal obesity was higher in 2017 (boys 36.3%, girls 25.5%) than in 2008 (15.7% and 10.5%; $p < 0.001$, respectively). In 2017, there was a 2.8 times increased prevalence risk of increased WC compared to 2008 ($p < 0.001$), which was directly related to 16.5 times increase in the risk of elevated sedentary behavior ($p < 0.001$) and two times increase who practice moderate–vigorous physical activity < 60 min/day ($p < 0.001$). **Conclusion:** The risk of abdominal obesity increased during the last decade in both sexes, which appears to be mainly due to the sedentary behavior, in addition to the lower level of moderate–vigorous physical activity in boys.

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Keywords: Sedentary behaviors, Waist circumference, Anthropometry, Adolescents, Physical activity.

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Article original

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TENDANCES DU COMPORTEMENT SÉDENTAIRE CHEZ LES

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ÉTUDIANTS DU SUD DU BRÉSIL

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Résumé

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Introduction: Le comportement sédentaire a été un sujet de préoccupation pour les chercheurs du monde entier, en particulier au Brésil. **Objectif:** Cette étude a comparé une activité physique modérée à vigoureuse et un comportement sédentaire sur deux ans de deux enquêtes (2008 et 2017), en reliant ces comportements au tour de taille. **Méthodes:** Étude transversale, auprès de 1 783 élèves, des deux sexes, âgés de 10 à 17 ans : 2008 (n = 977) et 2017 (n = 806). Les études ont été menées dans des écoles publiques d'une municipalité du sud du Brésil. Le niveau d'activité physique a été évalué à l'aide d'un questionnaire sur la dépense énergétique. Le tour de taille était considéré comme élevé \geq 75e centile pour l'âge et le sexe. Les élèves ont été regroupés selon des niveaux d'activité physique modérée à vigoureuse. Le temps passé assis était considéré comme un comportement sédentaire. **Résultats:** La proportion de garçons actifs en 2008 (62,2 %) était plus élevée qu'en 2017 (34,1 % ; $p < 0,001$), tandis que la fréquence de l'obésité abdominale était plus élevée en 2017 (garçons 36,3 %, filles 25,5 %) qu'en 2008 (15,7 % et 10,5 % ; $p < 0,001$, respectivement). En 2017, il y a eu une augmentation de 2,8 fois du risque de prévalence d'augmentation du tour de taille par rapport à 2008 ($p < 0,001$), ce qui était directement lié à l'augmentation de 16,5 fois du risque de comportement sédentaire élevé ($p < 0,001$) et deux fois plus élevé chez ceux qui pratiquent une activité physique modérée-vigoureuse < 60 min/jour ($p < 0,001$). **Conclusion:** Le risque d'obésité abdominale a augmenté au cours de la dernière décennie chez les deux sexes, ce qui semble être principalement dû à un comportement sédentaire, en plus du niveau inférieur d'activité physique modérée à vigoureuse chez les garçons.

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Mots clés: Comportement sédentaire, Circonférence abdominale, Anthropométrie, Adolescents, Activité physique.

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Artículo original

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TENDENCIAS EN EL COMPORTAMIENTO SEDENTARIO ENTRE ESTUDIANTES

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DEL SUR DE BRASIL

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Resumen

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Introducción: El comportamiento sedentario ha sido motivo de preocupación para investigadores de todo el mundo, especialmente en Brasil. **Objetivo:** Este estudio comparó la actividad física moderada-vigorosa y el comportamiento sedentario en dos años de dos encuestas (2008 y 2017), relacionando estos comportamientos con la circunferencia de la cintura. **Métodos:** Estudio transversal, con 1.783 estudiantes, de ambos sexos, con edades entre 10 y 17 años: 2008 (n = 977) y 2017 (n = 806). Los estudios se realizaron en escuelas públicas de un municipio del sur de Brasil. El nivel de actividad física se evaluó mediante un cuestionario de gasto energético. La circunferencia de la cintura se consideró alta \geq percentil 75 para la edad y el sexo. Los estudiantes fueron agrupados de acuerdo con los niveles de actividad física moderada-vigorosa. El tiempo sentado se consideró un comportamiento sedentario. **Resultados:** La proporción de niños activos en 2008 (62,2%) fue mayor que en 2017 (34,1%; $p < 0,001$), mientras que la frecuencia de obesidad abdominal fue mayor en 2017 (niños 36,3%, niñas 25,5%) que en 2008 (15,7% y 10,5%, $p < 0,001$, respectivamente). En 2017, hubo un aumento de 2,8 veces en el riesgo de prevalencia de aumento de la circunferencia de la cintura en comparación con 2008 ($p < 0,001$), lo que estuvo directamente relacionado con el aumento de 16,5 veces en el riesgo de alto sedentarismo ($p < 0,001$) y el doble en quienes practican actividad física moderada-vigorosa < 60 min/día ($p < 0,001$). **Conclusión:** El riesgo de obesidad abdominal ha aumentado en la última década en ambos sexos, lo que parece deberse principalmente al comportamiento sedentario, además del menor nivel de actividad física moderada-vigorosa en los varones.

Palabras clave: Sedentarismo, Circunferencia abdominal, Antropometría, Adolescentes, Actividad física.

136 **Introduction**

137 In the past decade, children and adolescents' sedentary behavior (SB) have increased,
138 which is attributable primarily to technological entertainment activities (ARAÚJO,
139 2022; BANDEIRA, 2018; KRAFFT, 2023; RIBEIRO, 2020). Studies indicate that the
140 increased spending time watching television, playing video games, and even using
141 smartphones excessively, leads to reduced sleeping time, which contributes to
142 inadequate eating habits that damage children and adolescents' health (BANDEIRA,
143 2018; TEIXEIRA, 2020).

144 The reduced participation in physical activities (PA) and the higher caloric consumption
145 have led to an increase in cardiometabolic diseases that decrease the quality of life in
146 adolescence and adulthood (TEIXEIRA, 2020). Increased body weight and the
147 accumulation of visceral fat is also prejudicial to their health because the increased
148 systemic inflammation, which is associated with type 2 diabetes, high blood pressure
149 and cholesterol, and some types of cancer (KONING, 2015; CARSON, 2016;
150 TEIXEIRA, 2020).

151 Accordingly, PA has been identified as an important component in a healthy lifestyle,
152 together with adequate nutrition, both of which improve all aspects of adolescents' lives
153 and development. Regular and adequate PA should be recognized as an essential
154 element to normal growth and development during adolescence, as well as reduced risk
155 of future diseases (PeNSE, 2021; WHO, 2020). To In order to obtain these health
156 benefits the current international recommendation that adolescents should practice at
157 least 60 minutes of moderate to vigorous intensity physical activities (MVPA) for at
158 least five days of the week, including muscle strength and stretching activities at least
159 three a week (WHO, 2021).

160 However, despite these recommendations, practicing MVPA regularly over 420 minutes
161 per week is not part of most adolescents' daily reality (CARSON, 2016). Instead, the
162 time adolescents devote to PA in their routines has declined and the time spent in SB
163 has increased. Nonetheless, no published studies to date have evaluated the 10-year
164 trend that Brazilian adolescents spends in practicing PA and having SB . In this sense,
165 two different cohorts at distinct times that shows different patterns of behaviour have
166 been shown important to analyze the influence of technological changes on MVPA and
167 SB routines and potential sex differences. In addition, we performed a temporal analysis
168 relating adolescents' behavioural changes and its association to the waist circumference,
169 since these changes lead to general and abdominal obesity (KONING, 2015).

170 The fact that comparing two different groups of adolescents in different years brings
171 indications of public policies and behaviors adopted for this population, as well as what
172 has been the direction and role of physical activity in this age group. Based on these
173 considerations, the objective of this study was to analyze changes in moderate–vigorous
174 physical activity (MVPA), sedentary behavior (SB), and waist circumference (WC) over
175 a period of time (2008 and 2017) in two cohorts of adolescents according to sex.

176 **Methods**

177 *Sample and Ethics Committee*

178 In both studies the public schools are different, but from the same municipality.
179 In the 2008 study, the sample was representative and 2017 was for convenience. In the
180 2008 study, the schools included in the study were intentionally divided by Curitiba
181 regions (north, south, east, west, and center). The schools were chosen by draw. In this
182 way, one school from each region was included in the analyses. The students were
183 evaluated according to their sex and age group. Probabilistic analysis was first
184 performed on all students enrolled in each educational institution according to sex,
185 before the sample size was evaluated according to the following criteria: (a) Total
186 number of boys and girls; (b) 95% confidence interval; and (c) sample error of 5% and a
187 prevalence of 50%, since the prevalence of risk factors in this population is unknown.
188 The study was approved by the Ethics Committee on Research in Human Beings of the
189 Federal University of Parana under registry CEP: 1466.131 / 2007-06 and CAAE:

190 0137.0.208.0007. The participants in the 2017 study were selected by simple random
191 sampling, from a nominal list of all students according to the age range for the survey.
192 Participants are also from one public school in the municipality of Curitiba. From the
193 total, 806 students that answered all questionnaires were subjected to anthropometric
194 assessments (weight and height) This research was approved by the Research Ethics
195 Committee of University Positivo - Paraná (Opinion 2,751,691/ 2018 and CAAE
196 Registry (80779117.3.3001.0102).

197

198 *Participants and Design*

199 The data for this observational and descriptive study was collected transversely
200 as part of an epidemiological survey. The study sample comprised 1,783 students
201 enrolled in public schools in the city of Curitiba, State of Paraná, in the years 2008 ($n =$
202 977) and 2017 ($n = 806$). 58.2% of the sample were girls ($n = 1,039$) and 41.8% ($n =$
203 744) were boys. The mean age was 14 years. Curitiba is in the southern region of Brazil,
204 in the east of the state of Paraná, specifically in its less wavy part. It is the capital of the
205 sixth most populous federative unit in Brazil. Curitiba uses the georeferencing system to
206 enroll its students. That is why there are different socioeconomic levels in each school
207 and region.

208

209 *Instruments*

210 The students were evaluated in their respective schools by by trained physical
211 education professionals. Waist circumference (WC) were measured in the morning and
212 students were instructed to wear light clothing. The WC was measured with flexible and
213 inextensible tape, accurate to 0.1 cm. The WC was considered elevated if above the 75th
214 percentile for age and sex, classified according to the approach adopted by Fernández
215 (2004).

216 The level of physical activity (PA) was assessed through an energy expenditure
217 questionnaire developed by Bouchard et al. (1983). The questionnaire consists of 96
218 periods, with activity recorded every 15-minutes, with daily activities classified into a
219 continuum of nine intensity categories (with category 1 corresponding to the lowest
220 intensity level), with the mean caloric expenditure is calculated for each recorded
221 activity. According to the estimated caloric expenditure, students were classified into
222 four groups: active (> 420 minutes of activity per week), sufficiently active (between
223 300 and 419 minutes of activity per week), insufficiently active (150–299 minutes of

224 activity per week), and inactive (less than 149 minutes of physical activity per week).
225 The durations of periods pertaining to lying down, sitting, light physical activity (LPA),
226 and moderate-vigorous physical activity (MVPA) were also recorded in minutes per
227 day. For analysis purposes, seated time was considered SB.

228

229 *Statistical Analyses*

230 The sample power of the study was calculated *a posteriori* using software
231 program G* Power 3 with the number of individuals in the full sample (1,783) and
232 MVPA as the dependent variable, OR: 2.078; prevalence of insufficient MVPA of 60%,
233 α of 0.05 and proportion of students (54%) that were evaluated in 2008, which
234 identified a power ($1 - \beta$) of 1.00 for the binomial logistic regression.

235 The studied variables were expressed in means and standard deviations, as well
236 as absolute and relative frequencies. Shapiro/Kolmogorov tests were used to assess used
237 to assess normality of the data distribution. To estimate the differences between means,
238 the Student t-test was applied for the parametric data while the Mann-Whitney U-test
239 was adopted for non-parametric data. The categorical variables were assessed via
240 Pearson / Yates chi-squared test. Odds ratio (OR) analysis with a 95% confidence
241 interval (CI) was conducted to identify the chance of having high time in SB and WC,
242 and insufficient PA between 2008 and 2017, adjusted for sex and age group. For all tests
243 a significance level of 5% was used and the sample yielded 95% test power. The
244 Statistic 10.0 (StatsoftR) software tool was used for all analyses.

245 **Results**

246 The general characteristics of the study are shown in Table 1. In the period
247 2008-2017, the mean age was similar for boys and girls. In 2008, both girls and boys
248 were heavier and taller compared to schoolchildren in the 2017 study ($p < 0.001$).

249 The girls in the 2017 study had higher abdominal circumference (25.4%) than
250 girls in 2008 (10%, $p < 0.001$). Mean time of MVPA and time lying down were higher
251 for both sexes in the 2008 study, while the mean levels of PA level, sitting time and
252 sedentary time were higher in the 2017 study. Boys and girls in the 2008 study were
253 more active than those in the 2017 study ($p < 0.001$), with exception in the group of girls
254 who practice physical activity above 420 minutes / week. (Table 1).

Table 1 - Characteristics of adolescents analyzed. Curitiba, Paraná, PR, Brazil.

Variables	2008 girls (n=559)	2017 girls (n=480)	P	2008 boys (n=418)	2017 boys n=326)	P
Age(years)	14,1±1,5	14,0±1,2	0,62	14,0±1,5	13,9±2,0	0,30
WC (cm)	64,3±10,5 ^a	66,6±8,4	<0,001*	76,6±9,4	70,3±9,4	<0,001*
MVPA (min/day)	25(0-640)	0(0-345)	<0,001**	85(0-545)	0(0-510)	<0,001**
LPA (min/day)	220(0-745)	255(15-600)	<0,001**	160(0-855)	240(30-585)	<0,001**
Sitting time(min/day)	510(0-1040)	615(195- 1110)	<0,001**	495(0-895)	615(90- 1020)	<0,001**
Time lying down(min/day)	580(0-1040)	525(90-900)	<0,001**	590(0-1040)	525(105- 1125)	<0,001**
PA <149 min/week	27.8±51.0	3.4±18.7	<0.0001**	22.0±45.7	3.7±19.4	0.01*
PA <299 -150 min/week	238.4±43.1	210	0.03*	240±38.4	210	0.003*
PA <419 -300 min/week	342.2±26.3	315	0.0001*	351.2±27.3	315	0.008*
PA >420 min/week	948.1±658.4	881.1±409.0	0.80	1055.1±528.8	914.7±503.8	0.004*

NOTE: Values expressed as means ± SD; WC waist circumference; MVPA moderate-vigorous physical activity; LPA light physical activity; PA physical activity; * t test (parametric variables); for non-parametric variables; ** Mann-Whitney test;

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256 Table 2 shows the relative frequencies of weight gain, increased circumference,
257 and different cuts in physical activity levels between 2008 and 2017.

258

Table 2. Relative frequencies of abdominal circumference and different cuts in physical activity levels between 2008 and 2017. Curitiba,Paraná,PR, Brazil.

Variables	2008 girls (%) (n=559)	2017 girls (%) (n=480)	P	2008 boys (%) (n=418)	2017 boys (%) (n=326)	P
Abdominal obesity	10.0	25.4	<0,001*	15.1	36.2	<0,001*
> 420 minutes/week	34	30.8	<0,001*	62.2	34.1	<0,0001*
<419-300 minutes/week	4.8	3.3	0.58	4.5	1.8	0.35

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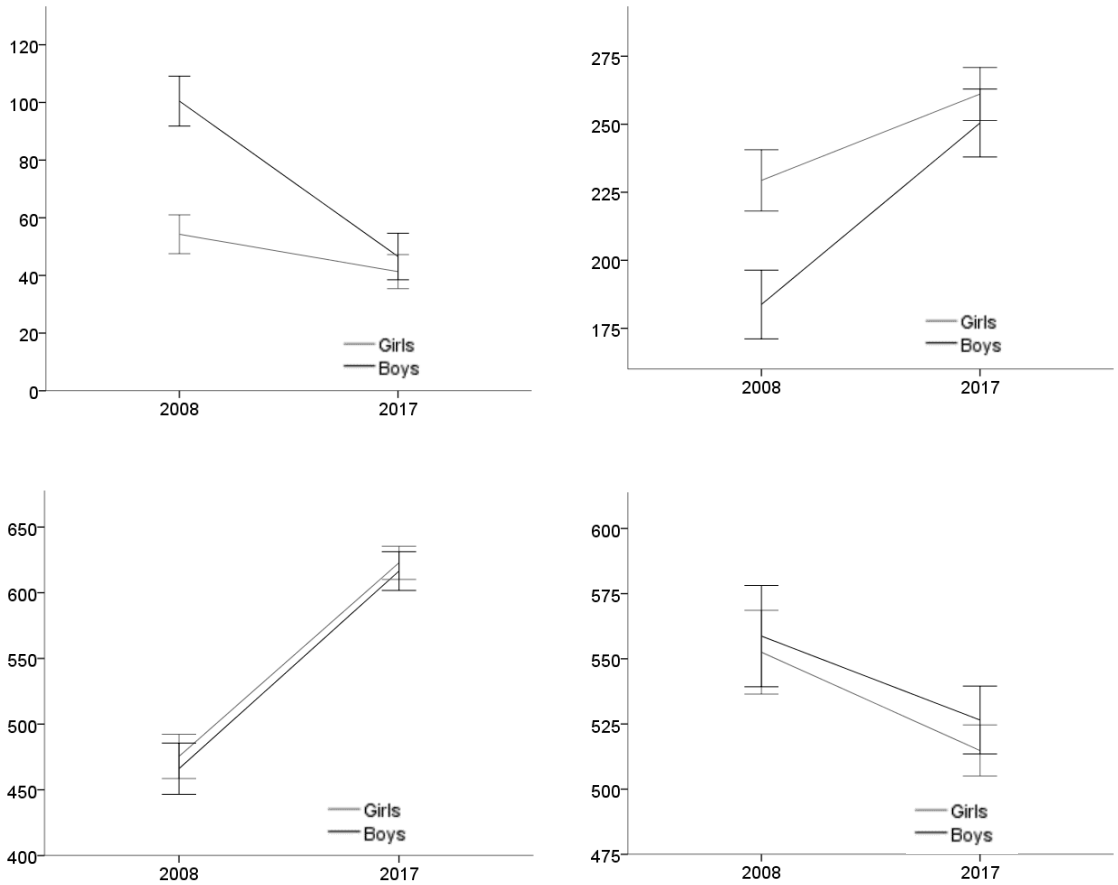
150-299 minutes/week	11.5	2.3	0.69	8.6	3.1	0.92
<149 minutes/week	49.7	63.6	<0.001*	24.7	61.0	<0.0001*

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260 Figure 1 presents a comparison between boys and girls in both periods in terms
261 of the daily time (in minutes) spent in MVPA, LPA, sitting and lying down activities.

262

Figure 1. Chart of the changes in the practice of light, moderate-vigorous physical activities, sitting and lying down time in girls and boys between 2008 and 2017. A - Mean practice of MVPA (min / day); B - Mean time in LPA (min / day); C - Mean sitting time in (min / day); D - Mean of lying down time (min / day).



263

264 Table 3 shows the risk for changes in lifestyle and waist circumference adjusted
 265 for sex and age. Over the 10-year period analyzed in this study, there was a significant
 266 increase in the risk of elevated WC, insufficient PA levels and SB ($p < 0.001$).

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Table 3- Risk of chance for changes in lifestyle and abdominal circumference. Curitiba, PR, Brazil.

	Odds Ratio OR	Confidence Interval (CI)	p
High WC	2.879	(2.215 - 3.740)	<0.001
SB>300min/day	16.482	(7.947 - 34.181)	<0.001
PA<420min/week	2.078	(1.682 - 2.567)	<0.001

Note: WC(waist circumference); SB (sedentary behavior); PA (physical activity); * adjusted by sex and age
 ** reference 2008;

Source: The Author (2019)

268 Discussion

269 The present study compared the practice of physical activities, sedentary
 270 behavior, and abdominal obesity of two cohorts of adolescents over a period of 10 years
 271 (2008 and 2017) and revealed that adolescents evaluated in 2017 presented worse
 272 outcomes than those evaluated in 2008, corroborating with other studies (SCHAAN,
 273 2019; YANG, 2019; WHO, 2020). Boys also presented lower frequency and time in
 274 MVPA than in playful activities. This reduction in PA and increase in SB in adolescents
 275 in recent years is worrisome. However, this is the first study that verified the time spent
 276 by Brazilian adolescents in physical activity and sedentary behavior in the period after
 277 10 years.

278 Studies such as Yang et al. (2019) pointed out that the practice of physical
 279 activity reduces the excess risk associated with sitting time. According to the World
 280 Health Organization (WHO), children and adolescents should be encouraged to perform
 281 at least 60 minutes of MVPA daily and that PA performed in amounts over 60 minutes
 282 per day provides additional health benefits.

283 In 2018, the Global Action Plan on Physical Activity (2018–2030) first adopted
 284 the reduction of sedentary behavior as one strategy for the prevention and control of
 285 chronic global disease (MCMILLAN, 2015). From this perspective, a systematic review
 286 study showed that most Brazilian adolescents spent more than two hours per day on

287 screen time (RIBEIRO, 2020). Similarly, 36% of Americans, 59.2% of Spanish
288 adolescents, and 80.6% of Canadians exhibit the same behavior (WHO, 2020). These
289 alarming results generate the need for special attention to SB. In the present study, the
290 risk of adolescents staying more than two hours per day in a sitting position increased
291 approximately 16.5-fold over the last decade. In addition, students spent more time
292 sitting in 2017, with a significant difference, showing that there was an increase in
293 sedentary behavior.

294 Another similar study among American adolescents found that in 2001–2016,
295 the estimated prevalence of watching television or video games for at least two hours in
296 the general period remained low and stable and the estimated prevalence of computer
297 use during leisure time increased across all age groups (WHO, 2020). In Brazil,
298 television time has declined over the last ten years, so there has been a change in
299 behavior among young people, particularly among boys, where cell phone and
300 smartphone technology has gained adherence from the public, which we define as
301 recreational time. Accompanying this increase, there was an increase in studies
302 reporting strategies to reduce screen-time exposure (STIERLIN, 2015; GUERRA, 2016;
303 Wafa, 2016).

304 Wafa et al. (2016) showed strong evidence that interventions aimed at reducing
305 recreational time and increasing physical activity or adopting a healthier diet were
306 effective for improving or maintaining weight. In contrast, Andermo et al. (2015)
307 observed a small effect among interventions where the goal was to reduce sedentary
308 behavior and therefore concluded that future studies should involve both children and
309 families in strategies to reduce sedentary behavior.

310 In Brazil, the results of the National School Health Survey (PeNSE, 2021),
311 which involved Brazilian adolescents in the ninth grade of elementary education
312 throughout all regions of the country and used the cut-off point of >300 min/week to
313 define MVPA, found that 44.0% of boys reported engaging in weekly physical activity
314 (PA) for ≥ 300 minutes, while slightly more than 25.0% of girls were in this group.
315 These results were similar to those found in our 2017 study (35.9% for boys). However,
316 among girls, our results were higher than those found in PeNSE (54.8%) and higher
317 than the average found in the state of Paraná (38.5%) (CUREAU, 2016). Another
318 nationwide school-based study involving Brazilian adolescents aged 12–17 years in
319 municipalities with >100,000 inhabitants, known as the Cardiovascular Risk Study in
320 Adolescents (ERICA, 2016), showed that more than half of Brazilian adolescents living

321 in medium- and large-size cities does not reach the recommendation of at least 300
322 min/week of physical activity in leisure for health promotion. This percentage is even
323 higher among girls, surpassing 70.0%. In Curitiba, 67.7% of the girls and 40.7% of the
324 boys engaged in PA for >300 minutes/week, these frequencies were much higher than
325 those found in our study, which is possibly because ERICA analyzed PA with a lower
326 cut-off than ours (CURITIBA, 2018).

327 This study found that, in both years, the risk of elevated WC, insufficient PA
328 levels and SB increased significantly among school children in the southern region of
329 Brazil. These results support the concern that overweight and obesity levels are
330 escalating. However, recent studies have begun to associate excess weight with
331 behavioral factors such as sitting time associated with the use of cell phones, tablets and
332 other electronics (STIERLIN, 2015; GUERRA, 2016; Wafa, 2016). Long periods of
333 sitting may increase the accumulation of body fat in the abdominal region, a factor that
334 leads to larger abdominal circumference sizes and other cardiometabolic risks,
335 beginning in early childhood and extending into adult life. Previous studies have shown
336 an association between increased visceral fat, abdominal obesity and increased
337 hypertension, the onset of type 2 diabetes, and some types of cancer and cardiovascular
338 diseases (YOUNG, 2016; RAJJO, 2017; GOLESTANZADEH, 2019; RING-
339 DIMITRIOU, 2019; LIMA, 2020; PADILLA-MOLEDO, 2020; TOZO, 2020).

340 Interventions that stimulate the transition from complete physical inactivity to
341 some activity, regardless of the amount or intensity of physical activity initially
342 practiced, may have an immediate impact on the health of these adolescents. This
343 strategy may be used complementary to programs aimed at maintaining or gradually
344 increasing the practice of physical activity. Outdoor active leisure activities are suitable
345 ways of promoting PA in adolescence (RAJJO, 2017; GOLESTANZADEH, 2019;
346 RING-DIMITRIOU, 2019; LIMA, 2020).

347 Moderate intensity physical activities, such as walking, pedaling or playing
348 sports, bring significant health benefits, especially in regard to energy balance and
349 weight control (RING-DIMITRIOU, 2019; YOUNG, 2016). For adults, the
350 recommendation of the American Heart Association is "Sit "Less, move more", because
351 there is insufficient evidence regarding the exact amount of sedentary behavior
352 negatively correlated with the maximization of the benefits to cardiovascular health
353 (EKLUND, 2016). Ekelund et al. (2016) showed that one hour of MVPA daily can
354 eliminate the harmful effects of eight hours of sitting time in men and women.

355 Nevertheless, sedentary screen time is likely to be more harmful to children and
356 adolescents than to adults.

357 In the face of what is observed in adults, the question that many researchers
358 have been asking themselves is: does the amount of physical activity practiced by more
359 physically active children compensate for the possible effects of sedentary behavior on
360 health? It is noteworthy that this was the first study that compared the behavior of
361 Brazilian adolescents with different levels of PA over a 10-year period. However, there
362 is a need for further research to clarify what exactly children do during the time spent
363 sitting. It is presumed that they were on their cell phones or using their computers for
364 recreation. In addition, due to the increased portability of electronic devices, the time
365 spent in the lying position should also be considered and future studies should seek to
366 identify the time spent on sleep and the time spent on electronic media. In this sense, it
367 is known that the lying position has been used to watch television and, more recently, to
368 use smartphones with various entertainment tools such as games and social media apps
369 as these factors may affect sleep pattern and routine (Wafa, 2016; ANDERMO, 2020;
370 WHO, 2020). The greater amount of time spent awake and the smaller amount of restful
371 sleep can lead to daytime drowsiness, attention deficits and hinder the execution of
372 daily activities, compromising their health as well as their performance at work and
373 school (Wafa, 2016). Future studies should fill these gaps in order to allow a better
374 understanding of the changes in the use of free time by young people.

375 This research has some limitations that should be taken into consideration. One
376 of them is its cross-sectional, which not allow to make inferences of causality. Another
377 limitation was the use of an activity recall questionnaire, which should be interpreted
378 with caution. In addition, the participants were not assessed for sexual maturation,
379 nutritional status, eating in front of the television, amount of time sitting spent with
380 electronic devices and with other activities. On the other hand, the instruments most
381 commonly used in epidemiological research and in clinical practice are questionnaires
382 and group or individual interviews, which seek to identify the discrepancies between the
383 actual and the desired body size, as well as associated feelings, emotions, behaviors and
384 attitudes. In addition to being simple, practical, and cheap, they can be used in
385 population studies and in clinical practice for a variety of purposes.

386

387 **Conclusion**

388 It is concluded that, the risk of prevalence of abdominal obesity increased in the
389 last decade in both sexes, appears to be associated with systemic inflammation. These
390 results raise the concern about the appearance of cardiometabolic risk factors in
391 schoolchildren. Moreover, the lower practice of MVPA in boys may be associated with
392 changes that more directly affected males, with more active daily activities being
393 replaced by sedentary activities. It is, therefore, important to reduce the sedentary
394 leisure habits among adolescents of both sexes, in addition to encouraging the practice
395 of MVPA, a habit that is associated with health promotion in all age groups.

396

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